PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-105491
(43)Date of publication of application : 09.04.2003

(51)Int.Cl. C22C 38/00
C21D 9/46
C22C 38/58
C23C 2/06
C23C 2/40

(21)Application number : 2001-298941
(22)Date of filing : 28.09.2001

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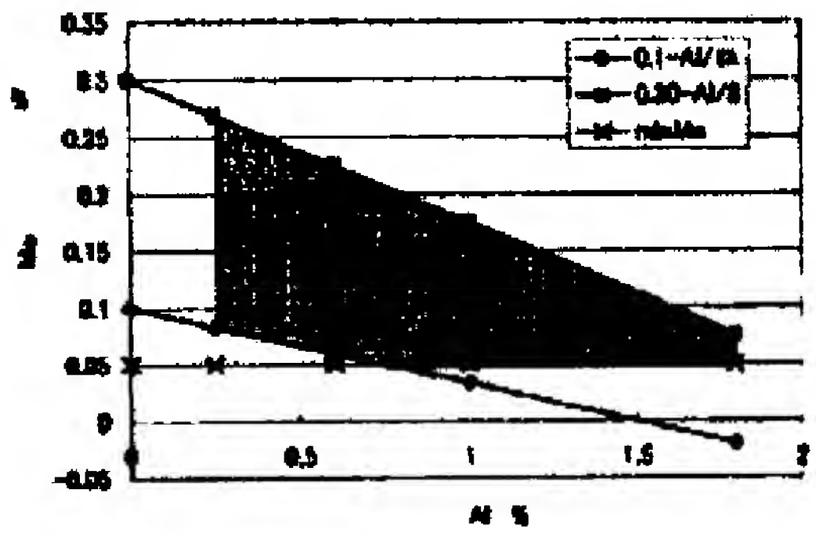
(54) HIGH STRENGTH STEEL SHEET AND GALVANIZED STEEL SHEET HAVING EXCELLENT FORMABILITY, AND PRODUCTION METHOD THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To realize a high strength steel sheet and a galvanized steel sheet which have excellent formability, and a production method for them on an industrial scale.
SOLUTION: The high strength steel sheet and the galvanized steel sheet having excellent formability have a composition containing, by mass, 0.08 to 0.3% C, <0.2% Si, 0.8 to 2.8% Mn, ≤0.03% P, ≤0.03% S, 0.25 to 1.8% Al, 0.05 to 0.3% Mo and ≤0.010% N, and further containing one or more metals selected from ≤1.0% Cu, ≤1.0% Ni and ≤1.0% Cr, and the balance Fe with inevitable impurities, and have each a metallic structure containing ferrite, ≥5% retained austenite, and bainite. Preferably, the mass% of Al, C, Mn and Mo satisfy a specified relational equation.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to a high intensity steel plate excellent in the moldability, a hot-dip zinc-coated carbon steel sheet, and a manufacturing method for the same.
[0002]
[Description of the Prior Art]In recent years, the weight saving of the body is further demanded for the fuel consumption improvement of a car. Although what is necessary is just to use steel materials with high intensity for the weight saving of the body, press-forming nature becomes difficult, so that intensity becomes high. This is because the elongation of steel materials falls, so that the intensity of steel materials generally becomes high. On the other hand, the TRIP steel (retained austenite steel) which held austenite to the room temperature has the high both sides of intensity and elongation, and came to be used for the skeleton member of a car recently.
[0003]However, since conventional TRIP steel was a component system containing Si exceeding 1%, hot-dip-zincing nature was [that plating does not adhere easily uniformly] bad, and there was a problem that chemical conversion nature was usually worse than steel materials. Although an austenite phase is stabilized by holding from 30 seconds in a 350-550 ** temperature requirement for 30 minutes at the time of continuous annealing as for retained austenite steel, Since common hot dip galvanizing equipment has many which do not have the equipment in which the above-mentioned isothermal holding is possible, retained austenite steel in which hot dip zincing is possible has been made difficult [manufacture] also in process also in ingredient.
[0004]Therefore, although TRIP steel was industrialized till the present only with hot rolled sheet steel, cold rolled sheet steel, or an electroplated steel sheet, the TRIP steel of the hot-dip coating steel plate was not industrialized. Although Si is reduced as a means to solve these problems and there is the patent No. 2962038 gazette as an example of a report which adds aluminum as an alternative element, A considerable quantity of aluminum is necessities, moreover, plating nature is not necessarily improved, and the operation range will also become narrow, and the actual condition has not resulted in industrialization.
[0005]Generally, the cooling rate of hot dip galvanizing equipment is as slow as 3 ** [/sec] order, perlite is formed by aluminum addition, there are few amounts of retained austenites and elongation is falling. Since alloying temperature usually became around 500 ** in alloying plating, it decreased, in order that bainite might become big and rough or retained austenite might carry out a transformation to bainite, and the characteristic had deteriorated.
[0006]
[Problem to be solved by the invention]This invention solves the problem of the above conventional technologies, and makes it SUBJECT to realize a high intensity steel plate excellent in the moldability, a hot-dip zinc-coated carbon steel sheet, and a manufacturing method for the same on a scale of industrial.

[0007]
[Means for solving problem]First, technical idea of this invention is explained. The result of having considered the high intensity steel plate this invention persons excelled [steel plate] in the moldability, and its hot-dip-zincing-ization, By reducing optimization of a steel composition, i.e., Si, and using aluminum as an alternative element, hot dip zincing is possible and it found out that retained austenite steel excellent in the both sides of intensity and elongation could be manufactured industrially by specifying the expression of relations of Mo, aluminum, C, and mass % of Mn. That is, even if it did not perform isothermal-holding processing, and ductility improved just like [conventional] remains austenitic steel and it performed alloying plating, that the characteristic deteriorates realized few high intensity steel plates.
[0008]By cooling with a suitable cooling rate, after performing the steel plate of the component system designed by the above-mentioned thought in continuous annealing or a continuous hot dip galvanizing line and performing recrystallizing annealing in a ferrite austenite two-phase region, The method of carrying out stable manufacture of this high intensity steel plate industrially was realized by making a ferrite into a main phase, finding out that the composite metal organization which contains retained austenite not less than 5% as a low-temperature-production phase can be obtained, and specifying the expression of relations of Mo, C, Mn, and the cooling rate in a continuous annealing process. This invention is based on above technical idea, and makes the contents of the following indicated to Claims the summary.
[0009]By mass %, (1) C:0.08 to 0.3%, less than [Si:0.2%], Mn:0.8-2.8%, P:0.03% or less, S:0.03% or less, aluminum : 0.25 to 1.8%, Mo : Contain 0.05 to 0.3%, and N:0.010% or less, and further, Cu: Less than 1.0%, less than nickel:1.0%, Cr: The high intensity steel plate excellent in the moldability, wherein it contains two of one sort or 1.0% or less of sorts or more, and it consists of the remainder Fe and an inevitable impurity and a metal texture contains a ferrite, not less than 5% of retained austenite, and bainite.
(2) The high intensity steel plate mass % of aluminum and Mo excelled [steel plate] in the moldability given in (1) satisfying the following (A) type.
0.10-aluminum/12 -- < -- Mo<0.30-aluminum/8 -- - (A)
[0010](3) A high intensity steel plate excellent in a moldability given in (1) to which mass % of C, Mn, and Mo is characterized by satisfying the following (B) type, or (2).
0.40<(C+Mn/6+1.5*Mo) <0.80 ... (B)
A high intensity hot-dip zinc-coated carbon steel sheet excellent in a moldability having a zinc plating layer on the surface of a high intensity steel plate given in (4), (1) to (3).
In a manufacturing method of a high intensity steel plate of a description, a steel plate after hot-rolling is rolled round at temperature of 450-600 ** to (5), (1) to (3), A manufacturing method of a high intensity steel plate excellent in a moldability, wherein it anneals at temperature of 750-850 ** after cold-rolling, and it cools speed more than seven (**/sec) in an annealing process and mass [of C, Mn, and Mo] % and cooling-rate CR (**/sec) in an annealing process satisfy the following (C) type.
1.3<(C+logCR+Mn/8+2*Mo) <2.4 ... (C)
In a manufacturing method of a high intensity hot-dip zinc-coated carbon steel sheet given in (6) and (4), Roll round a steel plate after hot-rolling at temperature of 450-600 **, and it anneals at temperature of 750-850 ** after cold-rolling, A manufacturing method of a high intensity hot-dip zinc-coated carbon steel sheet excellent in a moldability, wherein it cools speed more than seven (**/sec) at a hot-dip-zincing process and mass [of C, Mn, and Mo] % and cooling-rate CR (**/sec) in an annealing process satisfy the following (C) type.
1.3<(C+logCR+Mn/8+2*Mo) <2.4 ... (C)
Here, not less than 5% of retained austenite means here that not less than 5% is a retained austenite phase by an area rate in a metal texture photograph, and it measures using X-rays etc. A zinc plating layer means a plating layer which uses zinc as a main ingredient, and not only hot dip zincing

but alloyed hot dip zincing is included.
[0011]
[Mode for carrying out the invention]An embodiment of the invention is described in detail below. First, an ingredient of a high intensity steel plate of this invention and a Reason for limitation of a metal texture are explained. C is an indispensable ingredient as a basic element which stabilizes austenite from a viewpoint of intensity reservation. C is not [intensity] satisfied with less than 0.08%, and retained austenite is not formed. If it exceeds 0.3%, intensity can go up too much, ductility runs short, and it cannot be used as an industrial material. Therefore, the range of C in this invention is made into 0.08 to 0.3%, and is 0.1 to 0.22% preferably.
[0012]Mn is an element which delays generation of carbide in a viewpoint of intensity reservation in addition to being added, and is an element effective in generation of retained austenite. Intensity is not satisfied with less than 0.8%, and it becomes insufficient forming Mn of retained austenite, and ductility deteriorates. Ductility runs short and it cannot be used as an industrial material except that will change to retained austenite, martensite will generate, an intensity rise will be caused and variation in a product will become large by this, since hardenability increases if Mn addition exceeds 2.8%. Therefore, the range of Mn in this invention was made into 0.8 to 2.8%.
[0013]Since Si is an element effective in austenite generation as mentioned above in addition to adding in a viewpoint of intensity reservation, it is usually an element added for ductile reservation, but hot-dip-zincing nature will deteriorate by addition exceeding 0.2%. Therefore, 0.1% or less of the range of Si in this invention is desirable, when making it into 0.2% or less and thinking plating nature as important further. P is added according to an intensity level required as an element which raises intensity of a steel plate. However, local ductility is degraded in order to carry out a segregation to a grain community with many additions. Weldability is degraded. Therefore, P upper limit may be 0.03%.
[0014]S is an element which degrades local ductility and weldability by generating MnS, and is an element it is more desirable not to exist in steel. Therefore, a maximum is made into 0.03%. The minimum addition of Mo was made into 0.05%. By less than this, perlite is formed and a rate of retained austenite decreases. Since addition of excessive Mo might degrade ductile degradation and chemical conversion nature, it made a maximum 0.3%. Still more desirably, if 0.15% or less, higher intensity-ductility balance can be obtained.
[0015]aluminum is an element required in order to make austenite remain like the above-mentioned, and while there is an operation which stabilizes austenite by promoting generation of a ferrite and controlling generation of carbide, it acts also as a deoxidizing element. Even if it added aluminum too much on the other hand, the above-mentioned effect was saturated, and in order [that 0.25% or more needs to be aluminum added for austenite stabilization] to degrade hot-dip-zincing nature it not only to to embrittle steel on the contrary, but, it made the maximum 1.8%.
[0016]Although N is an element contained unescapable, since its AlN precipitation amount increases and it not only degrades prescription nature, but it decreases the effect of aluminum addition when it contains in a large quantity not much, 0.01% or less of its content is preferred. As for reducing N superfluously, since the cost like a steelworker increases, it is preferred to usually control to about 0.0020% or more. Although each of Cr(s), nickel, and Cu(s) was effective as a reinforcing element, since excessive addition might degrade ductile degradation and chemical conversion nature, they used less than Cr1.0%, less than nickel:1.0%, and less than Cu:1.0%.
[0017]The Reason for being characterized by the metal texture of this invention containing a ferrite, not less than 5% of retained austenite, and bainite as a main phase is that it becomes the steel plate excellent in intensity ductility balance when taking such an organization. When the rate of retained austenite will be not less than 5% especially, the intensity ductility balance of TSxEL goes up dramatically. Although about 1% of martensite may generate at the maximum, in a generated amount of this amount, intensity ductility balance of this invention is not degraded and it does not become a problem.
[0018]Furthermore, Mo is an ingredient which bears a very important role in retained austenite steel

which is an object of this invention. As opposed to aluminum added as a result of this invention persons' inquiring wholeheartedly It found out that there was an appropriate range of Mo expressed to the formula (A).
0.10-aluminum/12<Mo<0.30-aluminum/8 ... (A)
That is, retained austenite is not formed for Mo by less than 0.10-aluminum/12, and Mo is 0.30-aluminum/8. Above, intensity rises and ductility deteriorates. The range was displayed on drawing 1. The shadow area in a figure shows the appropriate range of Mo.
[0019]Mo is 0.1-aluminum/12. Although it is not clear about the Reason above sufficient retained austenite is formed, aluminum, It is a ferrite formation element, and to the ferrite molar fraction in a transformation-to-bainite start time increasing too much, although Mo is the same ferrite former, it controls the speed of the transformation [itself] and reduces a ferrite molar fraction. It is Mo 0.1-aluminum/12 By considering it as the above, a bainite molar fraction rises and it is surmised that retained austenite can be done mostly. Thus, it is thought by the interaction of Mo and aluminum that the amount of formation of retained austenite is determined. Especially this formula (A) is a relation obtained when Si addition which is the feature of this invention is low.
[0020]On the other hand, Mo is 0.30-aluminum/8. Above, it is thought that bainite reaction velocity reduces why ductility falls, and its retained austenite decreases. Furthermore, this invention persons repeated research and found out a formula (B).
0.40<(C+Mn/6+1.5*Mo) <0.80 ... (B)
A cooling rate after annealing is slow in about 3 **/[sec and], and perlite is easy to form a hot-dipping line. There is a case where alloying treatment is performed after annealing after being immersed in a zincky melting pot. In any case, it is a disadvantageous operating condition for making austenite remain. Then, this invention persons result in a formula (B), as a result of repeating examination wholeheartedly about Mo, C, and Mn.
[0021]That is, the amount of retained austenites of C+Mn/6+1.5*Mo will be 3% or less or less by 0.40, and TSxEl will deteriorate in about 18000MPa%. In 0.80% or more, intensity will rise, elongation will fall and TSxEl will deteriorate in about 18000MPa%. Although a Reason for the above is not clear, it is an interaction of Mo, C, and Mn and it is thought that the amount of formation of retained austenite is determined. A thing with a function to prevent retained austenite formed before and behind a melting pot from being decomposed at an alloying process can be conjectured.
[0022]The Reason for limitation of a manufacturing process of this invention is as follows. Recrystallizing annealing of the cold rolled sheet steel is first carried out by 2 phase coexisting temperature range of austenite and a ferrite. In this case, under influence of an element which makes retained austenites which raise hardenability, such as C and Mn, such as an element, aluminum, and Si, remain, C thickens in austenite and makes easy generation of retained austenite containing martensite by subsequent heat treatment. Manufacturing conditions of TRIP steel in usual cold rolled sheet steel perform cold rolling rolling at a hot-rolled process, and after coil ****, and perform the above-mentioned heat treatment in a continuous annealing furnace. In the case of a hot-dip zinc-coated carbon steel sheet, it plates with a molten zinc plating process with annealing after cold rolling. Heating alloying treatment may be performed after plating. Which systems, such as induction heating and gas heating, may be sufficient as a heating system.
[0023]This invention persons found out a formula (C) for examination in piles wholeheartedly about a cooling rate especially in this at the time of annealing in a molten zinc plating process.
1.3<(C+logCR+Mn/8+2*Mo) <2.4 ... (C)
CR is a cooling rate in an annealing process, and as for a unit, when **/seclogCR satisfies a formula (C), TSxEl shows a peak price. Or less by 1.3, perlite is not formed or retained austenite is no longer formed. On the other hand, martensite is formed so much, retained austenite decreases or a case of 2.4 or more is not formed. Therefore, intensity may become very high, ductility may fall and this value was made into a maximum.
[0024]Since it scrapes off after hot-rolling and temperature reaches 2 phase-equilibrium state

promptly in an annealing process, they are important conditions. That is, it is necessary to make cementite easy to dissolve by an annealing process by considering it as an organization for which perlite, or this small and bainite of an interval mixed an organization after hot-rolling. For the purpose, 600 ** or less is desirable. Also in order to control generating of a scale and to improve DESUKE nature, low-temperature **** is desirable. On the other hand, since cold-rolling will become difficult when a hard phase increases if **** temperature is too low, a minimum of **** temperature may be not less than 450 **.
[0025]Thus, annealing temperature [in / in obtained hot rolled sheet steel / pickling and . annealing process by which cold-rolling is carried out and with which annealing is presented], since a balanced austenite ratio became high, or it became austenite single phase and C in austenite would become thin if it becomes an elevated temperature, it was stabilized in subsequent cooling -- it becomes impossible to carry out austenite survival Therefore, a maximum of annealing temperature was 850 ** or less. On the other hand, since the dissolution of carbide becomes less enough when annealing is performed at low temperature, from a shortage of Sol.C, thickening of C of OSUTENAITOHE becomes less enough and a retained austenite ratio falls remarkably. Therefore, a lower limit was 750 **. By fulfilling the above-mentioned conditions, a high intensity steel plate excellent in a moldability and its hot-dip zinc-coated carbon steel sheet are realizable.
[0026]
[Working example](1) And an embodiment about invention of (4): Rolling-up heat treatment of hot-rolling was reproduced by manufacturing steel which has the component composition shown in Table 1 with a vacuum melting furnace, reheating to 1200 ** after cooling and solidification, performing finish rolling at 880 **, and holding at 600 ** after cooling for 1 hour. grinding removes a scale for an obtained hot-rolled board -- 70% -- it cold-rolled. After performing annealing for 770 **x 74 seconds and cooling to 450 ** with a cooling rate at 10 **/sec using a continuous-annealing simulator after that, in order to reproduce alloying treatment, it reheated to 500 **, and also cooled to a room temperature. 1% of skin pass rolling was performed after that.
[0027]
[Table 1]

表1

鋼種	C	Si	Mn	P	S	Al	Mo	N	Cu	Ni	Cr	区分
A	0.080	0.016	1.47	0.022	0.010	1.117	0.155	0.002	0.0001	0.0002	0.0001	本発明例
B	0.068	0.191	1.42	0.003	0.010	1.329	0.098	0.002	0.0001	0.0002	0.0001	本発明例
C	0.098	0.069	2.80	0.007	0.010	0.552	0.140	0.003	0.0001	0.0002	0.0001	本発明例
D	0.106	0.028	2.15	0.008	0.012	1.800	0.063	0.001	0.0001	0.0002	0.0001	本発明例
E	0.109	0.052	1.29	0.030	0.002	0.540	0.235	0.004	0.2400	0.0001	0.0002	本発明例
F	0.117	0.076	1.00	0.001	0.001	0.350	0.221	0.001	0.6002	0.0001	0.0002	本発明例
G	0.123	0.095	2.58	0.029	0.014	1.730	0.080	0.000	0.0002	0.0001	0.0002	本発明例
H	0.125	0.093	0.83	0.004	0.008	0.325	0.250	0.003	0.0002	0.0001	0.0002	本発明例
I	0.129	0.041	1.82	0.003	0.015	0.660	0.122	0.002	0.0002	0.0001	0.0002	本発明例
J	0.133	0.091	2.55	0.019	0.016	1.269	0.122	0.004	0.0002	0.0001	0.0002	本発明例
K	0.133	0.026	2.56	0.002	0.010	0.852	0.050	0.003	0.0001	0.0002	0.4900	本発明例
L	0.135	0.187	0.80	0.004	0.013	0.854	0.168	0.004	0.0002	0.0001	0.0002	本発明例
M	0.136	0.072	1.91	0.001	0.012	1.504	0.111	0.002	0.0002	0.0001	0.0002	本発明例
N	0.146	0.094	0.86	0.011	0.005	1.233	0.148	0.003	0.0002	0.0001	0.0002	本発明例
O	0.158	0.173	1.11	0.026	0.015	1.423	0.098	0.000	0.0002	0.0001	0.0002	本発明例
P	0.161	0.010	1.62	0.016	0.017	0.622	0.101	0.003	0.0002	0.0001	0.0002	本発明例
Q	0.169	0.148	1.60	0.025	0.015	1.426	0.114	0.004	0.0002	0.0001	0.0002	本発明例
R	0.174	0.198	1.63	0.007	0.019	1.373	0.105	0.002	0.0002	0.0001	0.0002	本発明例
S	0.182	0.121	1.55	0.027	0.030	0.250	0.062	0.003	0.0001	0.0002	0.0001	本発明例
T	0.185	0.029	2.44	0.026	0.023	1.017	0.300	0.005	0.0001	0.0002	0.0001	本発明例
U	0.184	0.126	1.38	0.027	0.019	0.840	0.102	0.002	0.0002	0.0001	0.0002	本発明例
V	0.190	0.100	2.32	0.017	0.009	0.302	0.061	0.002	0.0002	0.1920	0.0002	本発明例
W	0.194	0.148	1.51	0.017	0.018	0.802	0.185	0.002	0.0002	0.0001	0.0002	本発明例
X	0.203	0.111	2.59	0.013	0.001	1.033	0.103	0.003	0.0001	0.0002	0.0001	本発明例
Y	0.215	0.172	2.43	0.024	0.006	1.151	0.102	0.002	0.0002	0.0002	0.0001	本発明例
Z	0.216	0.172	1.36	0.010	0.012	1.078	0.102	0.004	0.0002	0.0001	0.0002	本発明例
AA	0.229	0.067	1.54	0.006	0.001	0.300	0.198	0.002	0.0001	0.0002	0.0001	本発明例
AB	0.245	0.051	0.98	0.007	0.014	1.656	0.064	0.003	0.0002	0.0002	0.0001	本発明例
AC	0.261	0.140	1.58	0.002	0.002	0.386	0.066	0.010	0.0002	0.0001	0.0002	本発明例
AD	0.262	0.141	2.29	0.005	0.011	1.350	0.089	0.000	0.0001	0.0002	0.0001	本発明例
AE	0.266	0.005	2.01	0.005	0.018	1.275	0.113	0.003	0.0002	0.0001	0.0002	本発明例
AF	0.268	0.169	1.59	0.004	0.011	0.912	0.123	0.002	0.0002	0.0002	0.0001	本発明例
AG	0.291	0.013	1.76	0.017	0.023	1.024	0.125	0.003	0.0002	0.0001	0.0002	本発明例
AH	0.300	0.158	1.98	0.022	0.015	0.850	0.098	0.002	0.0002	0.0001	0.0002	本発明例
AI	0.078	0.110	1.80	0.020	0.010	0.506	0.080	0.003	0.0001	0.0002	0.0002	比較例
AJ	0.324	0.100	2.00	0.020	0.020	0.070	0.124	0.001	0.0002	0.0002	0.0001	比較例
AK	0.138	0.320	1.60	0.020	0.010	0.898	0.140	0.004	0.0001	0.0002	0.0001	比較例
AL	0.129	0.120	0.40	0.030	0.020	0.767	0.080	0.004	0.0002	0.0002	0.0002	比較例
AM	0.141	0.180	3.20	0.015	0.022	0.702	0.134	0.003	0.0002	0.0001	0.0002	比較例
AN	0.134	0.040	1.70	0.030	0.020	0.185	0.060	0.004	0.0002	0.0001	0.0002	比較例
AO	0.174	0.180	2.22	0.030	0.020	1.903	0.100	0.002	0.0001	0.0002	0.0001	比較例
AP	0.124	0.110	1.70	0.030	0.020	0.534	0.025	0.003	0.0002	0.0001	0.0002	比較例
AQ	0.155	0.140	2.02	0.030	0.020	0.612	0.320	0.004	0.0002	0.0002	0.0001	比較例

[0028]
[Table 2]

表2

実験番号	鋼種	TS(MPa)	EL(%)	TS×EL	残留γ率(%)	めっき性	合金化	区分
1	A	560	34	19040	8.7	○	○	実施
2	B	589	33	19437	7.9	○	○	実施
3	C	601	33	19833	9.6	○	○	実施
4	D	612	35	21420	8.4	○	○	実施
5	E	665	30	19950	6.1	○	○	実施
6	F	572	35	20020	7.8	○	○	実施
7	G	596	37	21652	9.5	○	○	実施
8	H	622	34	21148	10.1	○	○	実施
9	I	578	36	20808	9.6	○	○	実施
10	J	596	35	20965	10.3	○	○	実施
11	K	605	34	20570	9.2	○	○	実施
12	L	632	34	21488	11.5	○	○	実施
13	M	620	35	21700	12.4	○	○	実施
14	N	678	29	19662	5.2	○	○	実施
15	O	665	33	21945	10.7	○	○	実施
16	P	620	36	22320	12.7	○	○	実施
17	Q	672	34	22848	11.4	○	○	実施
18	R	702	32	22464	12.1	○	○	実施
19	S	654	31	20274	6.0	○	○	実施
20	T	630	30	18900	5.1	○	○	実施
21	U	645	34	21930	12.4	○	○	実施
22	V	623	34	21182	9.8	○	○	実施
23	W	732	32	23424	11.5	○	○	実施
24	X	712	33	23496	10.9	○	○	実施
25	Y	724	33	23892	11.4	○	○	実施
26	Z	735	32	23520	10.5	○	○	実施
27	AA	701	28	19628	9.9	○	○	実施
28	AB	665	29	19845	9.4	○	○	実施
29	AC	712	27	19224	5.2	○	○	実施
30	AD	735	27	19845	7.8	○	○	実施
31	AE	742	28	20776	11.4	○	○	実施
32	AF	795	26	20670	12.5	○	○	実施
33	AG	632	33	20856	13.2	○	○	実施
34	AH	815	26	21190	12.4	○	○	実施
35	AI	523	26	13598	2.3	○	○	比較
36	AJ	795	22	17490	8.5	○	○	比較
37	AK	592	30.5	17751	6.4	×	×	比較
38	AL	514	26	13364	3.2	○	○	比較
39	AM	768	19	14592	5.4	○	○	比較
40	AN	501	31	15531	2.3	○	○	比較
41	AO	612	34	20808	8.9	×	×	比較
42	AP	590	35	16650	1.5	○	○	比較
43	AQ	669	25	17325	2.1	○	○	比較

★ 残留γ以外の組織は、フェライトが60～70%、ベイナイトが全体からフェライトと残留オーステナイトを除いた比率で存在している。
★ 実験番号10,20,31については、上記組織以外にマルテンサイトが1%以下で含有されていた。

[0029]The direction tension of L of a JIS No. 5 test piece for tensile test estimated tractive characteristics, and a product of TS(MPa) xEL (%) made more than 18000MPa% good. A metal texture measured observation with an optical microscope, and a rate of retained austenite by an X diffraction. A ferrite was observed by the Nay Taal etching and martensite was observed by REPERA etching. A rate measuring method of retained austenite is performed in a field which carried out chemical polishing from a surface of a test specimen board up to 1/4 thickness, Under [a fixed quantity / retained austenite / (200) by monochrome-ized MoK alpha rays of a ferrite and (211) (200) of surface integral intensity and austenite, (220), and (311) surface integral intensity to]. A rate of retained austenite made not less than 5% good. In an experimental result of Tables 2, 4, 6, and 7, a rate [this rate of retained austenite] of remains gamma was written.
[0030]The plating performance made fitness (=O) the case where performed molten zinc plating, checked the adhesion condition of plating visually, and it had adhered uniformly in the area beyond inner 90% of a plating side by the hot-dip-zincing simulator after giving the same annealing conditions as the above. About alloying, three or less marks were made into fitness (=O) by powdering examination. An experimental result is shown in Table 2.
[0031]Since C is too low, experimental run number 35 and the ingredient sign A.I. Artificial Intelligence of formation of retained austenite are insufficient, and TSxEL's is insufficient. In

experimental run number 36 and the ingredient sign AJ, since C is too high, TSxEL falls by intensity rising too much and stretch falling. In experimental run number 37 and the ingredient sign AK, since Si is too high, hot dip zincing does not adhere uniformly but serves as an appearance defect. Alloying was also poor. Since Mn is too low, intensity is not satisfied with experimental run number 38 and the ingredient sign AL, and the rate of retained austenite is also low. In experimental run number 39 and ingredient sign AM, according to Mn being too high, intensity rose, stretch fell and TSxEL fell. In experimental run number 40 and the ingredient sign AN, since aluminum is too low, sufficient retained austenite is not formed, but elongation is insufficient. In experimental run number 41 and the ingredient sign AO, since aluminum was too high, hot dip zincing did not adhere uniformly, but the appearance defect was caused, and alloying was also poor. Since experimental run number 42 and ingredient sign AP had too low Mo, perlite generated, and the rate of retained austenite fell. In experimental run number 43 and the ingredient sign AQ, since Mo was too high, intensity rose too much, stretch fell and TSxEL ran short.

[0032]On the other hand, in the experimental run number 1 which is an embodiment of this invention - 34 and ingredient sign A-AH, since the range of this invention was fulfilled, a good result was brought. (2) And the embodiment about invention of (4): Vacuum melting of the steel of the ingredient shown in Table 3 was carried out, the specimen was created by the same method as the embodiment of invention of (1), and each characteristic was investigated by the same experiment.

[0033]

[Table 3]

表3

鋼種	C	Si	Mn	P	S	Al	Mo	N	Cu	Ni	Cr	残部	式(A)		
													0.1-Al/12	Mo	0.3-Al/8
AR	0.060	0.17	1.53	0.030	0.010	0.82	0.20	0.003	0.0001	0.0002	0.4900	Fe及び不可避的不純物	0.048	0.201	0.223
AS	0.062	0.00	1.00	0.006	0.028	1.55	0.09	0.003	0.0001	0.0002	0.0001	Fe及び不可避的不純物	-0.037	0.085	0.094
AT	0.066	0.07	2.15	0.002	0.015	0.94	0.18	0.002	0.0020	0.0002	0.0001	Fe及び不可避的不純物	0.021	0.177	0.182
AU	0.122	0.16	1.96	0.021	0.023	1.14	0.14	0.003	0.0002	0.0001	0.0010	Fe及び不可避的不純物	0.005	0.143	0.158
AV	0.152	0.18	1.50	0.008	0.003	0.82	0.20	0.001	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.048	0.201	0.223
AW	0.154	0.03	2.89	0.029	0.023	0.85	0.15	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.021	0.152	0.182
AX	0.156	0.10	1.84	0.016	0.019	0.27	0.12	0.000	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.077	0.120	0.266
AY	0.169	0.06	1.13	0.011	0.019	0.93	0.18	0.001	0.0001	0.0002	0.0001	Fe及び不可避的不純物	0.022	0.182	0.163
AZ	0.197	0.03	0.90	0.013	0.026	0.26	0.05	0.002	0.0002	0.1900	0.0003	Fe及び不可避的不純物	0.077	0.052	0.266
BA	0.198	0.19	1.16	0.008	0.005	0.54	0.22	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.055	0.222	0.239
BB	0.212	0.18	1.95	0.028	0.002	0.82	0.16	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.049	0.160	0.223
BC	0.217	0.15	2.65	0.015	0.011	0.40	0.25	0.004	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.067	0.245	0.250
BD	0.224	0.00	1.06	0.029	0.007	0.85	0.12	0.005	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.029	0.121	0.194
BE	0.234	0.17	1.80	0.000	0.009	1.45	0.11	0.002	0.2400	0.0001	0.0002	Fe及び不可避的不純物	-0.021	0.105	0.119
BF	0.278	0.05	0.97	0.026	0.023	1.58	0.10	0.002	0.0001	0.0002	0.0001	Fe及び不可避的不純物	-0.032	0.095	0.102
BG	0.283	0.05	1.64	0.001	0.018	1.36	0.11	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	-0.015	0.107	0.128
BH	0.222	0.13	2.09	0.019	0.009	1.20	0.25	0.001	0.0010	0.0012	0.0002	Fe及び不可避的不純物	0.007	0.250	0.150
BI	0.108	0.02	1.03	0.003	0.011	0.38	0.04	0.003	0.0030	0.0020	0.0001	Fe及び不可避的不純物	0.068	0.035	0.253

[0034]

[Table 4]

表4

実験番号	鋼種	TS(MPa)	EL(%)	TS×EL	残留γ率(%)	めっき性	合金化	区分
43	AR	578	36	20808	8.7	○	○	本発明例
44	AS	562	38	21356	8.9	○	○	本発明例
45	AT	603	35	21105	10.2	○	○	本発明例
46	AU	609	34.5	21010.5	9.8	○	○	本発明例
47	AV	610	36	21960	11.2	○	○	本発明例
48	AW	632	34	21488	9.4	○	○	本発明例
49	AX	622	35	21770	10.5	○	○	本発明例
50	AY	615	36	22140	10.1	○	○	本発明例
51	AZ	613	35	21455	9.7	○	○	本発明例
52	BA	599	36	21564	11.5	○	○	本発明例
53	BB	634	35	22190	12.5	○	○	本発明例
54	BC	578	34	23052	13.4	○	○	本発明例
55	BD	685	35	23975	12.2	○	○	本発明例
56	BE	642	34	21828	11.9	○	○	本発明例
57	BF	645	33.5	21607.5	10.7	○	○	本発明例
58	BG	698	33	23034	13.2	○	○	本発明例
59	BH	735	24	17640	1.5	○	○	比較例
60	BI	550	32	17600	1.2	○	○	比較例

[0035]The experimental result is shown in Table 4. Since the content of Mo was higher than 0.3-aluminum/8, intensity rose too much, ductility fell and the construction material of experimental run number 59 and ingredient sign BH was insufficient. Since the content of Mo was lower than 0.1-aluminum/12, sufficient retained austenite phase was not formed but the construction material of experimental run number 60 and the ingredient sign BI was insufficient. On the other hand, in the experimental run number 43 - 58 and ingredient sign AR-BG, since the range of this invention was fulfilled, a good result was brought.

[0036](3) And the embodiment about invention of (4): Vacuum melting of the steel of the ingredient shown in Table 5 was carried out, the specimen was created by the same method as the embodiment of invention of (1), and each characteristic was investigated by the same experiment.

[0037]

[Table 5]

表5

鋼種	C	Si	Mn	P	S	Al	Mo	N	Cu	Ni	Cr	残部	式(B)
													C+Mn/6+1.5xMo
BJ	0.092	0.02	2.16	0.022	0.027	0.54	0.13	0.004	0.0002	0.0030	0.0002	Fe及び不可避的不純物	0.840
BK	0.103	0.07	1.06	0.015	0.012	0.49	0.08	0.003	0.0010	0.0001	0.0002	Fe及び不可避的不純物	0.402
BL	0.123	0.10	1.07	0.003	0.014	0.52	0.09	0.004	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.418
BM	0.131	0.15	2.29	0.019	0.0041	1.30	0.11	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.879
BN	0.133	0.09	1.70	0.013	0.018	0.44	0.19	0.002	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.865
BO	0.151	0.19	0.61	0.002	0.003	0.23	0.23	0.002	0.0020	0.0002	0.0001	Fe及び不可避的不純物	0.852
BP	0.180	0.02	2.02	0.026	0.004	0.98	0.10	0.005	0.0005	0.0001	0.0002	Fe及び不可避的不純物	0.844
BQ	0.186	0.18	2.44	0.016	0.027	1.15	0.08	0.001	0.0001	0.0002	0.0006	Fe及び不可避的不純物	0.871
BR	0.201	0.09	1.74	0.003	0.029	0.93	0.18	0.002	0.0001	0.0002	0.0500	Fe及び不可避的不純物	0.761
BS	0.219	0.14	1.61	0.026	0.003	0.85	0.17	0.003	0.0002	0.0001	0.0005	Fe及び不可避的不純物	0.742
BT	0.228	0.13	1.53	0.016	0.004	1.12	0.09	0.003	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.616
BU	0.235	0.15	2.24	0.028	0.004	0.39	0.08	0.004	0.0001	0.0002	0.0001	Fe及び不可避的不純物	0.838
BV	0.237	0.13	0.86	0.015	0.020	0.26	0.27	0.003	0.0001	0.0002	0.0001	Fe及び不可避的不純物	0.792
BW	0.247	0.14	0.96	0.017	0.006	0.47	0.22	0.005	0.0250	0.0010	0.0009	Fe及び不可避的不純物	0.741
BX	0.208	0.04	1.76	0.002	0.020	1.09	0.19	0.002	0.0010	0.0001	0.0002	Fe及び不可避的不純物	0.765
BY	0.233	0.15	1.23	0.000	0.013	1.52	0.24	0.002	0.0002	0.0220	0.0002	Fe及び不可避的不純物	0.788
BZ	0.250	0.10	2.44	0.018	0.006	1.72	0.07	0.000	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.792
CA	0.092	0.01	0.95	0.004	0.005	0.79	0.08	0.000	0.0002	0.0001	0.0002	Fe及び不可避的不純物	0.370
CB	0.250	0.16	1.25	0.013	0.022	0.36	0.25	0.003	0.0002	0.0002	0.0001	Fe及び不可避的不純物	0.850

[0038]

[Table 6]

表6

実施番号	鋼種	TS(MPa)	EL(%)	TS×EL	残留γ率(%)	めっき性	合金化	区分
61	BJ	582	35	20370	8.4	○	○	本発明例
62	BK	568	34	19312	7.5	○	○	本発明例
63	BL	594	35	20790	7.9	○	○	本発明例
64	BM	612	34	20808	9.8	○	○	本発明例
65	BN	603	35	21105	11.2	○	○	本発明例
66	BO	643	33	21219	10.2	○	○	本発明例
67	BP	625	36	22500	12.4	○	○	本発明例
68	BQ	633	34	21522	10.4	○	○	本発明例
69	BR	658	34	22372	11.6	○	○	本発明例
70	BS	723	32	23136	12.4	○	○	本発明例
71	BT	705	32	22560	10.7	○	○	本発明例
72	BU	695	32	22240	10.2	○	○	本発明例
73	BV	712	31	22072	9.5	○	○	本発明例
74	BW	758	30	22740	11.4	○	○	本発明例
75	BX	624	33	20592	9.3	○	○	本発明例
76	BY	735	31	22785	10.1	○	○	本発明例
77	BZ	765	29	22765	12.4	○	○	本発明例
78	CA	523	32	16736	1.3	○	○	比較例
79	CB	825	21	17325	1.6	○	○	比較例

[0039]The experimental result is shown in Table 6. In experimental run number 78 and ingredient sign CA, C+Mn/6+1.5xMo=0.37 and because of 0.4 or less, retained austenite will be 3% or less, and is insufficiency of construction material. In experimental run number 79 and the ingredient sign CB, C+Mn/6+1.5xMo=0.85 and for 0.8 or more, since intensity rose and ductility fell, TSxEL fell. On the other hand, the range of this invention is fulfilled by the experimental run number 61 - 77 and ingredient sign BJ-BZ, and a good result was brought by them.

[0040](5) And the embodiment about invention of (6) : The inside of steel of the ingredient of Table 1, About the ingredient sign B, D, and F and I of a typical ingredient, L, P, R, U, Z, and AD. It carried out to cold rolling by the same method as the embodiment of invention of (1), and cooled after annealing by continuous annealing and a hot-dip-zincing simulator with the cooling rate shown in Table 7, the specimen was created by the after that still more nearly same method as invention of (1), and each characteristic was investigated by the same experiment. Similarly the result is shown in Table 7.

[0041]

[Table 7]

表7

実験番号	鋼種	冷却速度	C	Mn	Mo	式(C)	TS(MPa)	EL(%)	TS×EL	残留γ率(%)	めっき性	合金化	区分
79	B	7	0.088	1.42	0.099	1.309	576	35	20160	6.8	○	○	本発明例
80	D	7	0.106	2.15	0.063	1.345	901	35	21035	7.9	○	○	本発明例
81	F	7	0.117	1.00	0.221	1.530	585	35	19775	6.6	○	○	本発明例
82	I	7	0.129	1.62	0.122	1.445	565	36	20340	8.4	○	○	本発明例
83	L	7	0.135	0.82	0.188	1.419	611	34	20774	10.1	○	○	本発明例
84	P	7	0.161	1.62	0.101	1.411	602	35	21070	11.1	○	○	本発明例
85	R	7	0.174	1.63	0.105	1.439	685	31	21235	10.2	○	○	本発明例
86	U	7	0.184	1.38	0.102	1.405	622	33	20526	11.0	○	○	本発明例
87	Z	7	0.216	1.36	0.102	1.438	715	31	22165	9.8	○	○	本発明例
88	AD	7	0.262	2.29	0.089	1.571	721	30	21630	6.4	○	○	本発明例
89	B	30	0.088	1.42	0.099	1.941	592	36	21312	8.4	○	○	本発明例
90	D	30	0.106	2.15	0.063	1.977	622	35	21770	8.8	○	○	本発明例
91	F	30	0.117	1.00	0.221	2.182	582	35	20370	7.6	○	○	本発明例
92	I	30	0.129	1.62	0.122	2.077	592	35	20720	9.4	○	○	本発明例
93	L	30	0.135	0.82	0.188	2.051	622	33	20526	11.1	○	○	本発明例
94	P	30	0.161	1.62	0.101	2.043	623	36	22428	12.4	○	○	本発明例
95	R	30	0.174	1.63	0.105	2.065	712	33	23496	13.5	○	○	本発明例
96	U	30	0.184	1.38	0.102	2.037	657	34	22338	13.3	○	○	本発明例
97	Z	30	0.216	1.36	0.102	2.068	752	31	23312	11.5	○	○	本発明例
98	AD	30	0.262	2.29	0.089	2.204	740	31	22940	8.5	○	○	本発明例
99	B	3	0.088	1.42	0.099	0.941	552	29	16008	1.4	○	○	比較例
100	I	3	0.129	1.62	0.122	1.077	547	31	16957	1.2	○	○	比較例
101	P	3	0.161	1.62	0.101	1.043	584	28	16352	0.8	○	○	比較例
102	U	3	0.184	1.38	0.102	1.037	610	26	15860	2.0	○	○	比較例
103	AD	3	0.262	2.29	0.089	1.204	682	26	17732	1.6	○	○	比較例
104	B	100	0.088	1.42	0.099	2.464	852	25	21300	2.5 *1)	○	○	比較例
105	I	100	0.129	1.62	0.122	2.600	839	26	21814	2.2 *1)	○	○	比較例
106	P	100	0.161	1.62	0.101	2.586	668	24	16032	3.6 *1)	○	○	比較例
107	U	100	0.184	1.38	0.102	2.560	710	23	16330	2.4 *1)	○	○	比較例
108	AD	100	0.262	2.29	0.089	2.726	785	21	16485	1.4 *1)	○	○	比較例

*1) 実験番号104～108については、金属組織の中に3%～5%の多量のマルテンサイトを含有していた

[0042]About the experimental run number 99 - 103 and an ingredient sign B, I, and P, U, and AD, since the cooling rate (=CR) was low in 3 **/[sec and], the formula 3 was not satisfied, and, as a result, sufficient retained austenite was not formed, but construction material was poor. About the experimental run number 104 - 108 and an ingredient sign B, I, and P, U, and AD, since the cooling rate was too quick in 100 **/[sec and], the formula 3 was not satisfied, but, as a result, 3% - 5% of a lot of martensite generated during the organization, and it became poor [construction material] because intensity becomes high too much and ductility gets worse. The rate of retained austenite also fell.

[0043]On the other hand, about the experimental run number 79 - 88 and an ingredient sign B, D, and F, I, L, P, R, U, Z, and AD, in order to carry out a cooling rate in 7 **/[sec and] and to satisfy the invention type (C) of (5), a good result was brought. Also about the experimental run number 89 - 98 and an ingredient sign B, D, and F, I, L, P, R, U, Z, and AD, the cooling rate was carried out in 10 **/[sec and], the formula (C) of (5) was satisfied, and a good result was brought.

[0044]

[Effect of the Invention]According to this invention, since the high intensity steel plate and hot-dip zinc-coated carbon steel sheet excellent in the moldability which are used for autoparts etc. can be provided, it is worthy invention industrially.

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

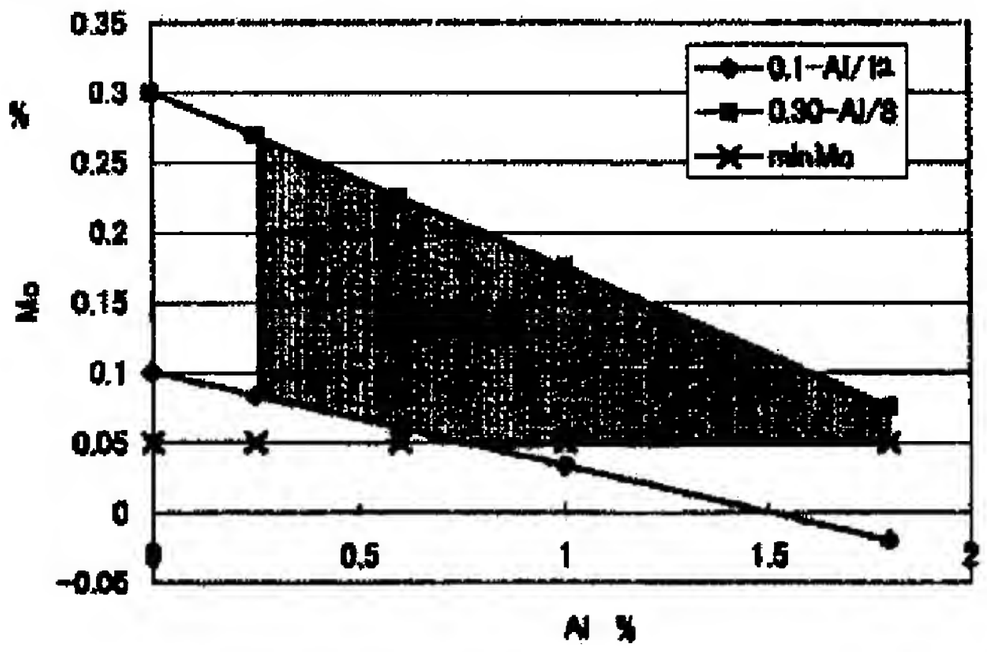
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]By mass %, C:0.08 to 0.3%, less than [Si:0.2%], Mn:0.8-2.8%, P:0.03% or less, S:0.03% or less, aluminum : 0.25 to 1.8%, Mo : Contain 0.05 to 0.3%, and N:0.010% or less, and further, Cu: Less than 1.0%, less than nickel:1.0%, Cr: A high intensity steel plate excellent in a moldability, wherein it contains two of one sort or 1.0% or less of sorts or more, and it consists of the remainder Fe and an inevitable impurity and a metal texture contains a ferrite, not less than 5% of retained austenite, and bainite.
[Claim 2]A high intensity steel plate mass % of aluminum and Mo excelled [steel plate] in the moldability according to claim 1 satisfying the following (A) type.
0.10-aluminum/12<Mo<0.30-aluminum/8 ... (A)
[Claim 3]A high intensity steel plate mass % of C, Mn, and Mo excelled [steel plate] in the moldability according to claim 1 or 2 satisfying the following (B) type.
0.40<(C+Mn/6+1.5*Mo) <0.80 ... (B)
[Claim 4]A high intensity hot-dip zinc-coated carbon steel sheet excellent in a moldability having a zinc plating layer on the surface of the high intensity steel plate according to claim 1 to 4.
[Claim 5]In a manufacturing method of the high intensity steel plate according to claim 1 to 3, a steel plate after hot-rolling is rolled round at temperature of 450-600 **, A manufacturing method of a high intensity steel plate excellent in a moldability, wherein it anneals at temperature of 750-850 ** after cold-rolling, and it cools speed more than seven (**/sec) in an annealing process and mass [of C, Mn, and Mo] % and cooling-rate CR (**/sec) in an annealing process satisfy the following (C) type.
1.3<(C+logCR+Mn/8+2*Mo) <2.4 ... (C)
[Claim 6]In a manufacturing method of the high intensity hot-dip zinc-coated carbon steel sheet according to claim 4, a steel plate after hot-rolling is rolled round at temperature of 450-600 **, Anneal at temperature of 750-850 ** after cold-rolling, and it cools speed more than seven (**/sec) at a hot-dip-zincing process, And a manufacturing method of a high intensity hot-dip zinc-coated carbon steel sheet mass [of C, Mn, and Mo] % and cooling-rate CR (**/sec) in an annealing process excelled [hot-dip zinc-coated carbon steel sheet] in a moldability satisfying the following (C) type.
1.3<(C+logCR+Mn/8+2*Mo) <2.4 ... (C)

[Translation done.]

Drawing selection [Representative drawing]



[Translation done.]